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Protecting Structures From Wildland Fire

Cover: A Forest Service cabin before and after being wrapped with foil wrapping material.

Protecting Structures From Wildland Fire

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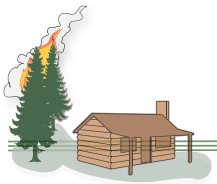

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Introduction

The U.S. Department of Agriculture, Forest Service has many remote structures, such as lookouts and historic cabins, that must be protected from wildfires (figure 1). This document provides guidance for Forest Service employees about current structure protection techniques based on information provided by Federal land management agency employees, Web sites, and vendors. It does not include fall protection guidance. The information in this document is intended for use by agency employees to help protect Government property and is not intended to provide structure protection guidance for homeowners in the urban interface environment. Use of this information does not guarantee a structure will be saved. For more information on alternative structure protection techniques, refer to "Structure Protection Materials Evaluation" (1251–1811–SDTDC) at <http://fsweb.sdtdc.wo.fs.fed.us/pubs/pdf/12511811.pdf>.

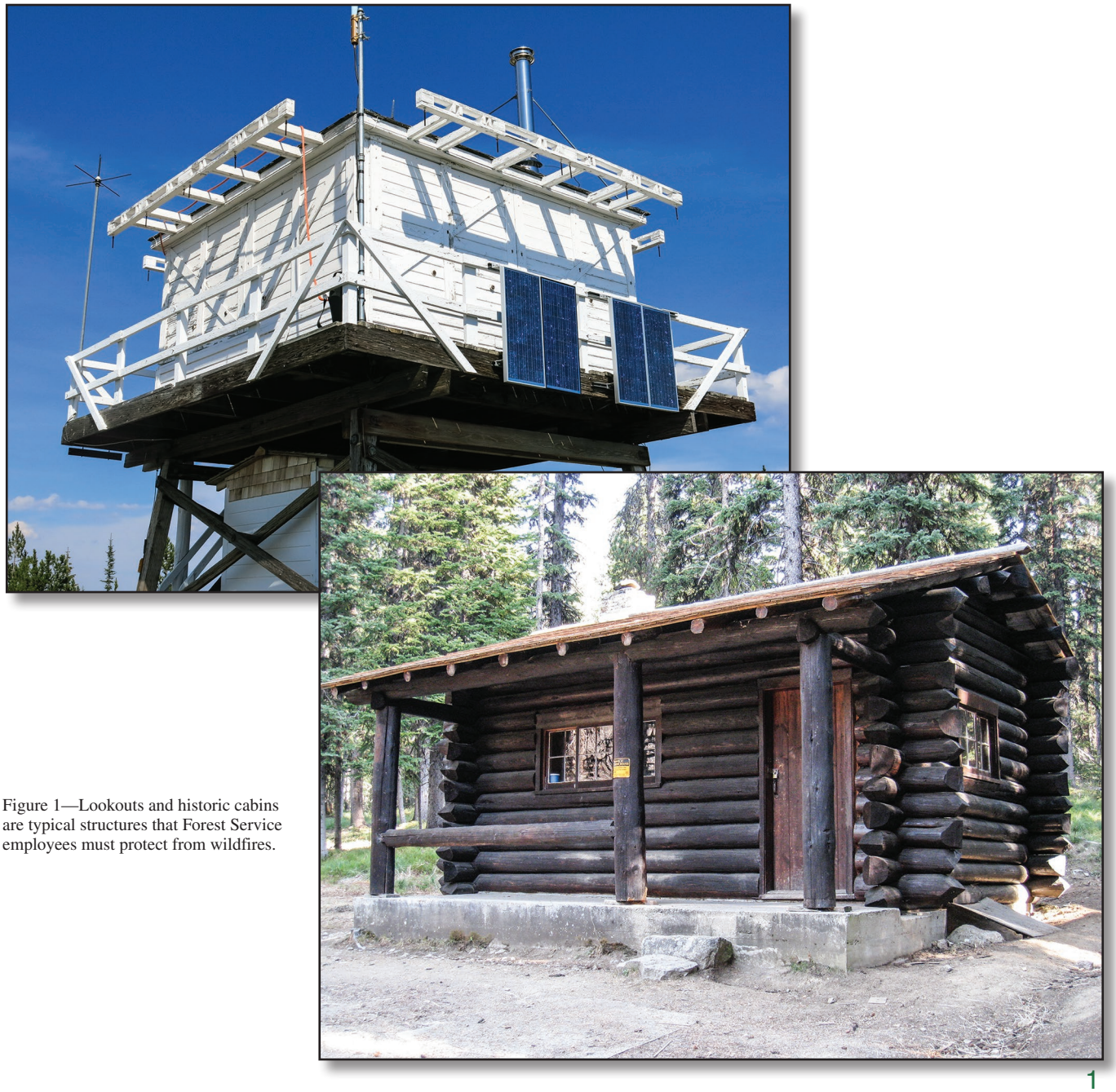

Figure 1—Lookouts and historic cabins are typical structures that Forest Service employees must protect from wildfires.

Ignition Sources

Structures can ignite because of radiant heat, contact with flames, or embers. For radiant heat alone to ignite a structure, long periods of intense heat are required. In a typical forest fire, the duration of flames at distances beyond 60 to 100 feet from a structure is too brief to cause ignition solely by radiant heat. The effects of radiant heat may be reduced by removing fuel from around a structure, covering the structure with wrapping material to reflect the heat, and applying water, foam, or gel to cool the structure.

Contact with direct flame occurs when vegetation or other combustible material is located too close to a structure. While large flames from a flame front may appear to be the biggest threat, small flames that make contact with the structure or attachments may be more likely to cause ignition. Removing surface and ladder fuels near the structure is the best way to reduce the potential for direct flame contact.

Embers are a major source of ignition for a structure or fuel surrounding a structure. Embers can travel one-half mile or more during intense wildfires and high concentrations of embers can occur within one-quarter mile of their source. Embers can cause delayed ignition of a structure after the danger appears to have passed. They can ignite fuels in hard-to-reach areas, such as roofs, gutters, and under eaves, and can penetrate openings, such as open windows and vents, both above and below the structure. Closing all openings in a building prevents embers from entering. Cleaning all combustible material from a building and its surroundings can help prevent ignition of light fuels that might in turn ignite the building. Applying wrapping material can help prevent embers from contacting combustible surfaces and starting fires. Water, foams, and gels can extinguish embers before they cause ignition, but are often difficult to apply in places where embers can collect or penetrate.

Hazards

Protecting remote structures can include hazards in addition to those normally associated with firefighting. These additional hazards may include:

- **Working on roofs—**Fall-protection equipment and training is required for anyone working more than 4 feet above the ground (figure 2).

Figure 2—Fall protection is required when working on roofs and other surfaces that are more than 4 feet above the ground.

- **Electrical power—**Turn off all power to the structure, including generators. If possible, have the power company de-energize the powerlines before beginning work. Keep ladders, wrapping material, sprinklers, and poles away from powerlines.
- **Hazardous materials—**Be aware of gas cans, propane cylinders, cylinders of compressed gases, pesticides, and other hazardous materials that can be physical hazards or create toxic smoke when burning. Remove these materials from the area if possible. Ensure that every crewmember knows where the materials are located.
- **Fuel tanks located uphill from the structure or worksite—**The wooden supports of some fuel tanks can fail during a fire and cause the tank and its flammable contents to roll downhill into the structure or work area. Fire can also cause fuel lines to rupture and ignite fuel that can flow into the structure or work area.
- **Cuts and skin irritation from the wrapping material—**The edges of the wrapping material can cause cuts and the fiberglass backing can irritate the skin.
- **Slipping hazards—**Wrapping material is extremely slippery to walk on, especially when wet. Foams, gels, and retardants are also extremely slippery.
- **Falls while handling large pieces of wrapping material—**Wrapping material can provide a large

surface for the wind to catch, creating a potentially dangerous situation for crewmembers installing wrapping material on a roof.

- **Falling objects—**Objects can be dislodged or dropped by workers on ladders or the roof and can fall on the workers below.
- **Back strains from lifting and twisting—**Working on a ladder or on the roof can result in awkward body positions for moving material and equipment.

The most important thing to remember is that no structure is worth your life.

Historic Structures and Complexes

Be sure to consult with an archaeologist or heritage specialist if you are protecting a historic structure or complex. Working with the archaeologist or heritage specialist allows you to effectively protect the structure while maintaining its historic and cultural value.

Considerations for Equipment Delivery

Many Forest Service structures are located in remote locations, including roadless areas. Common methods for delivering equipment and supplies to these locations include motor vehicles, packstrings, helicopters, and paracargo. Other methods include boat and float planes. For a list of equipment and materials you may require, refer to appendix A.

When delivering equipment and supplies by vehicle, things to consider include:

- Can the equipment be delivered on time?
- Is the risk from driving mountain roads greater than having the equipment delivered by air?

When delivering equipment and supplies by packstring, things to consider include:

- Can the equipment be delivered on time?
- Is the size and weight of the wrapping material and other equipment manageable for packing?

When delivering equipment and supplies by helicopter (figure 3), things to consider include:

- Is the flying distance far enough and the load size large enough that paracargo would be more efficient?
- Could smoke or weather suspend flight operations?
- Are there trees, wires, and other flight hazards in the delivery area that must be removed?
- Are the size and weight of the wrapping material and other equipment compatible with helicopter cargo operations?
- If the cargo area is not near the worksite, do you have a way to transport the cargo from the cargo area to the worksite?
- If the cargo is delivered near the worksite, will the rotorwash have an impact on safety or work progress?
- Is a qualified helicopter crewmember needed at the site to receive or backhaul cargo?
- Could the helicopter be called away for more urgent needs, such as bucket drops?

Figure 3—Ensure that the size and weight of wrapping materials and equipment are compatible with helicopter cargo operations.

When delivering equipment and supplies by paracargo, things to consider include:

- Is the flying distance near enough that a helicopter would be more efficient?
- Could smoke or weather suspend flight operations?
- Can a drop zone of sufficient size (one-half acre minimum) be found near the structure?
- Are there trees, wires, and other flight hazards in the delivery area?
- Do you have a good way to transport equipment from the drop zone to the worksite? Do you need pack frames dropped along with the cargo?
- Could the cargo hang up in the trees? Do you have a way to retrieve it if it does?

Figure 4—This cabin has a shake roof that can easily be ignited by embers.

For more information on helicopter flight safety and risk assessment, refer to the "Interagency Helicopter Operations Guide" (PMS 510) at <http://gacc.nifc.gov/sacc/logistics/aircraft/IHOG.pdf> or the aviation section of the "Incident Response Pocket Guide" (PMS 461) at <http://www.nwcg.gov/pms/pubs/pms461/pms461.pdf>.

For more information on paracargo operations safety, refer to the aviation section of the "Incident Response Pocket Guide."

Fuel Reduction

The key to reducing the ignition potential of a structure is reducing the flammability of the structure and its immediate surroundings (Cohen 2000). The best way to do this is to construct buildings from fire-resistant materials and to create an area immediately surrounding the structure that reduces a fire's intensity. Unfortunately, many Forest Service buildings are constructed of highly flammable materials (figure 4) and are surrounded by an abundance of wildland fuels. Because of this, your actions will be limited to reducing the fuels on and around the structure as best you can and decreasing the flammability of the structure by using wrapping material, water, foam, or gel. Some steps you can take to reduce fuel on and around the structure are:

- Remove needles, leaves, nests, and other flammable debris from the roof, deck surfaces, drain gutters, window framing, and other crevices on the structure.
- Remove flammable material from under the deck and crawl spaces.
- Remove all flammable material at least 36 inches away from the base of each wall.
- Trim grass down to the "nubs" for at least 36 inches from each side of the structure and to within 2 to 3 inches of the ground for another 10 to 15 feet beyond that. This helps prevent flame from coming in contact with the structure.
- Remove combustible furniture from the deck and place it inside the building.
- Remove flammable material from around any structure attachments, such as fences and boardwalks, and wrap the attachments as necessary. Consider any flammable attachment to be part of the structure and protect it like you would the structure. If you feel you cannot adequately protect the attachment, then remove it from the structure. If you are removing an attachment from a historic structure, consult with your archaeologist or heritage specialist on how best to remove the attachment.
- Ensure that any stacks of firewood are at least 30 feet from the structure (figure 5).

Figure 5—Move firewood piles at least 30 feet away from the structure.

- Remove dry horse or mule manure.
- Remove portable propane tanks and gasoline containers. These may be placed inside the structure.
- Remove fuels from the supports and entry decking of bridges.

Figure 6—Close shutters or install plywood over windows before installing wrapping material.

Sealing Openings

Seal all openings to prevent embers from entering. Close all doors and windows and leave them unlocked. Close the shutters (figure 6). Cover the windows with plywood or boards if the structure does not have shutters. This will prevent damage to the window if the building is wrapped and will reduce the chance of glass breaking because of heat or an accident. Broken windows must be covered to prevent embers from entering the building. Whether the windows are covered with shutters or plywood, ensure there are no gaps at the top of the window covering that could create an ember trap between the window and the covering. Close all vents and cover them with wrapping material (figure 7). Seal the chimney opening. This is especially important on buildings where the inner chimney is removed but the outer chimney remains for appearances. Check for woodpecker holes that you may need to seal.

Figure 7—Cover vents with wrapping material to prevent embers from entering the structure.

Inside Corners

Inside corners, such as window framing, where a deck connects to a building, where a dormer meets the roof, where handrail supports meet the deck surface, and other dead air spaces, are especially vulnerable areas on a structure (figure 8). Inside corners tend to trap flammable debris and embers. Once ignited, the geometry of the corner radiates heat back on the burning area, sustaining the flames. On railings and other attachments, this can cause the burning area to spread along the corner until it ignites the structure. Remove all flammable debris from inside corners and protect them from embers with wrapping material or by other means.

Figure 8—Inside corners, such as the place where a wall meets a catwalk, should be protected from embers.

Rotten Wood

Many back-country structures are susceptible to wood rot. Rotten areas of wooden structures ignite more easily and sustain flames better than areas of sound wood. Check for rotted areas and protect these areas from embers and contact by flame.

Applying Wrapping Material

Wrapping material is aluminum foil bonded to a fabric backing such as fiberglass (information about wrapping material manufacturers and products can be found in appendix B). The aluminum foil reflects about 95 percent of radiant heat and prevents embers from contacting the surface of the structure. Wrapping material only withstands limited contact with flames before it begins to delaminate and fail. Remove fuels from around the structure that could ignite and expose the wrapping material to contact by direct flame. Wrapping material may be used for applications where no water is available. Where water is available, some vendors recommend installing sprinkler or soaker hose under the wrapping material to provide an extra layer of protection against embers. As an alternative to sprinkler hose, one vendor recommends using 1-inch fire hose with ⅛-inch holes drilled 18 inches apart through one side. Install the hoses horizontally using rubber cushioned steel loop straps and face the sprinkler holes toward the structure. Locate the hoses about 1 foot below the top of each vertical wall and on each side of the roof about 2 feet below the peak. If you use water together with wrapping material, wrap the structure completely before turning on the water. Remember, the wrapping material is extremely slippery when wet.

Staples are the traditional method used for attaching wrapping material to a structure. Staples are lightweight, quick, and easy to install. They can, however, pull out easily if they are not properly installed and can consequently create stress points that make the wrapping material easy to tear. Placing fiberglass webbing over an area to be stapled

and then stapling through the webbing may help reduce tearing. You can install staples using manual staplers or hammer staplers. Hammer staplers are quick and easy to use but can damage fragile portions of a structure, such as window framing, shake roofs, and rolled asphalt roofing. To avoid logistics problems and confusion during wrapping, ensure that all staplers are equipped with the same size staples.

As an alternative to staples, one vendor recommends securing wrapping material using metal straps with holes (also known as plumbers tape) and nails or screws. Another vendor recommends securing wrapping material by using a cordless drill to install 1⅝-inch long deck screws and 1¼-inch diameter fender washers every 3 to 5 feet. Nails or screws can cause more damage to a structure than staples because the nails or screws leave larger holes. On the other hand, when you use plumbers tape or washers, fewer screws or nails may be required to secure wrapping material to the structure.

Chicken wire and staples can also be used to support and secure wrapping material under floor joists.

Before wrapping a structure, remove all combustible material from the building and surrounding area. Seal all openings. If the door to a building must remain accessible during wrapping, leave extra wrapping material for the last person onsite to cover the door. Pad all sharp edges or protrusions, such as metal roof edges and bolts, with layers of wrapping material, carpeting, or foam so they do not tear the wrapping material (figure 9). Do not use duct tape to pad wooden surfaces on historic structures; the tape may pull wood off when it is removed. If possible, remove any protruding nails, staples, or wire, or drive them flush with the surface to prevent puncturing the wrapping material. Dampen the area surrounding the base of the structure before wrapping it if you have time and access to water. The wrapping material will help keep the area moist when it is applied on top of this dampened area and will make the structure less vulnerable to ignition from embers.

When wrapping the walls of a structure, begin at the bottom and leave a skirt of about 12 inches of wrapping material on the ground. The skirt prevents embers from starting a fire against the side of a structure where flames can get between the wrapping material and the wall. Anchor the skirt to the ground with nonflammable material, such as rocks, mineral soil, or sand bags (figure 10). Work your way up the side of the structure from the bottom to avoid creating seams that can catch embers. Overlap each panel at least 6 inches. Keep the wrapping material as close to the building as possible to reduce loose material that might get caught by the wind. Mark the location of the door to ensure easy access to the building.

Figure 9—Pad protrusions, such as bolts, before applying wrapping material.

Figure 10—Create a skirt of wrapping material on the ground to prevent embers from starting a fire against the side of a building. Anchor the skirt with rocks or other nonflammable materials.

When wrapping the roof, leave plenty of extra material to wrap under the eaves and to overlap the wall-wrapping material. Attach the wrapping material to the underside of the eaves and along the wall so that it overlaps the wrapping material on the wall (figure 11).

Figure 11—Attach the wrapping material to the underside of the eaves and along the wall to prevent the wind from damaging it.

Wrapping material applied across the ridge of a roof can create perpendicular seams that may be more exposed to the wind than wrapping material applied parallel to the ridge. Perpendicular roof seams may require additional reinforcement, such as extra staples, fiberglass webbing, or alternate attachment methods. Some roofs are equipped with membranes that must not be punctured by staples. The wrapping material on these types of roofs may be held down using boards attached to other parts of the structure. Cover the boards with wrapping material before installing them (figure 12). If you use heavy objects or other methods to help hold wrapping material down, ensure that the materials are not flammable, will not trap embers, and will not roll off the roof.

Seal all seams with aluminum foil tape to reduce the possibility that the seams will separate in the wind (figure 13). Be sure to use aluminum foil tape and not silver-colored plastic tape.

When wrapping a deck, create a skirt to prevent embers from entering beneath the deck. Wrap railings and pillars that are made out of wood or other combustible materials. Protect the inside corners where the handrails meet the deck and where the deck meets the main structure. If people will be going in and out of the structure, wrap the decking surface last.

Figure 12—This cabin has a sod roof with a membrane underneath that must not be punctured. The roof wrapping material is held down by boards that are attached to another part of the structure. The boards are wrapped with wrapping material before they are installed.

Figure 13—Seal seams in the wrapping material with aluminum foil tape to prevent the seams from separating in the wind.

Remove vegetation around railings, pillars, fences, and any other combustible items that attach to or near the main structure. Wrap any attachments to the main structure. Remove attachments from the main structure if you cannot adequately protect them.

Structures may remain wrapped for a month or more. During this time, the structure may be exposed to short, intense blasts of wind from the fire or thunderstorms, or to longer-term wind events. Wind is the greatest enemy to maintaining a properly wrapped structure. Ensure that the wrapping material is properly secured to withstand wind over an extended period of time.

Propane Tanks

Some structures have large propane tanks nearby that cannot be moved (figure 14). If a large propane tank is present, shut off the propane at the main tank valve. Remove vegetation and other combustible materials from around the tank and lines. Wrap the tank with wrapping material if you have time.

Figure 14—Remove vegetation and other combustible materials from around large propane tanks and their lines. Ensure that the tank valve is closed.

Gasoline or Diesel Tanks

Some structures have gasoline or diesel tanks located nearby. Ensure that the fuel level in the tank is low enough that the tank will not vent liquid fuel if it is heated by a fire. Many of these fuel tanks have support structures made of wood. Clear all vegetation and other combustible material at least 10 feet from the support structure. Wrap the supports and fuel tank if there is time. Gasoline or diesel tanks located uphill from a structure or work area present special hazards; a failure of the tank supports can cause the tank and its contents to roll into the structure and a failure of the fuel lines can cause burning fuel to flow into the structure.

Water Handling

Where water is available, it can be used to cool the structure, quench embers, and reduce the flammability of surrounding vegetation. If you use sprinkler systems, set them up to provide water coverage over the entire structure. Any building that is protected with sprinklers should be sealed to prevent water damage to the inside of the building. Use sprinklers to wet any fuels surrounding the structure as well as propane tanks, fuel tanks, etc. Do not direct sprinklers toward energized powerlines. Mount sprinklers on poles or tripods made from surrounding trees and raise them into position from the ground to provide roof coverage. Protect the hoses from fire damage.

Foams and gels (also known as water enhancers) may increase the effectiveness of water in protecting structures by enabling the water to cling to vertical surfaces. Foams and gels must be kept wet to be effective; their effectiveness is lost once they dry. Some gel vendors claim that their products can be rehydrated with water to regain their effectiveness. No studies have been conducted to date to determine the effectiveness of rehydrated gels after they have initially dried. Only foams and gels found on the qualified products list (QPL) may be used by Federal land management agencies. Refer to appendix C for the Web address of the QPLs. Foams and gels can be applied by ground equipment near waterways, such as streams or lakes, but take precautions to prevent these chemicals from entering the water. Retardants, foams, and gels applied from the air must not be dropped within 300 feet of a waterway. Gels can be very difficult to remove from a structure once they are applied. Refer to appendix C for information on the effects that foams and gels have on structures, tips for removing foams and gels from structures, and a list of foam and gel vendors.

Water may weaken the bond between the fiberglass cloth and aluminum foil of the wrapping material. If the cloth and foil remain in contact, the bond will return to normal strength once the water evaporates and the wrapping material dries. If you intend to reuse wrapping material, ensure that it is completely dry before storing it.

Removing Wrapping Material

Remove the wrapping material after the danger to the structure passes. If you used sprinklers, allow the outside of the wrapping material to dry before removing it. Some wrapping material is designed to be reused, so don't cut or tear it until you determine if it is disposable. Remove staples with

pliers, a flat-blade screwdriver, a small pry bar, or a staple remover such as the type sold by office supply stores. If you use a screwdriver or small pry bar, apply finger pressure to the top of the staple while removing it to ensure that both legs of the staple come out of the wood. Otherwise, you'll need pliers to completely remove the staple. Be careful to not pull pieces of wood from the structure while removing staples. Do not discard staples on the ground where they may cause injury or flat tires. Use a tool belt with a pouch or some other method to collect the discarded staples. You can use a magnetic floor sweeper to clean up staples that are discarded on the ground. If you plan to reuse the wrap, ensure that both sides are completely dry before folding or rolling the wrap for storage.

Preassembled Kits

On forests where structures are located in fire-prone areas, structure protection kits can be preassembled for each individual structure. These kits can contain the wrapping material, fasteners, materials for sealing openings, equipment for clearing fuels, etc. If space permits, you can prestage the kits at the structure so that they are readily available in case of fire. The wrapping material has a shelf life of several years if stored correctly. Store the wrapping material in its original, unopened package in a dry location that does not contact the ground or concrete. Do not store the wrapping material in a corrosive environment. Inspect the kits periodically to ensure that equipment and materials have not been removed or damaged.

Costs

Protecting remote structures is costly. Wrapping material costs ranged from about $415 to $786 per roll (not including shipping) at the time this publication was written. Estimates given after the 2000 fire season ranged from $10,000 to $15,000 to wrap a cabin. This includes the cost and transportation of the equipment and materials and the labor to install them.

Conclusion

Wrapping can be an effective way to protect structures, especially in remote locations where no water is available. While wrapping can be expensive, most structures cost much more to replace than to wrap. Some historic and administrative structures cannot be replaced, regardless of cost.

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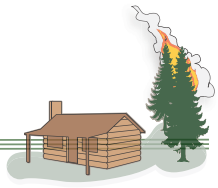

Appendix A—Equipment and Materials

Equipment for clearing fuels—

- Chain saws
- Weed eaters
- Lawnmowers
- Handtools (Pulaskis, shovels)
- Leaf blowers for removing leaves, needles, and grass trimmings from around the structure and leaves and needles from the roofs, gutters, decks, and other locations on the structure
- Rakes or McLeods for removing leaves, needles, and grass trimmings from around the structure
- Brooms for removing leaves and needles from roofs, gutters, decks, etc.
- Drip torches, fusees, etc. for igniting back fires
- Equipment for sealing the structure
- Plywood
- Boards
- Saws for cutting plywood and boards
- Sheet metal
- Nails
- Hammers

Equipment for attaching wrapping material—

- Wrapping material (see appendix B)
- 25- or 30-foot measuring tape (one per person)
- Utility knives with extra blades
- Staplers (one per person)—be sure to use the same size staples in all staplers
- Staples
  - ✧ Size—½ inch to 9/16 inch
  - ✧ Amount—enough to install staples at 8- to 10-inch intervals
- Equipment for attaching wrap using attachment methods other than staples
  - ✧ Cordless drills with extra batteries
  - ✧ Screwdriver bits for drills (bring extras)
  - ✧ 1¼-inch outside diameter fender washers for no. 10 or ¼-inch screws
  - ✧ No. 6 or no. 8 deck screws, 1⅝ inches long
  - ✧ Plumbers tape (metal strapping with holes)
- Fiberglass webbing
- Aluminum foil tape at least 2 inches wide: ensure that this is not metallic-colored polymer tape. Brands that the Forest Service has successfully used include Nashua 322 and 324A (available from Home Depot) and Reflectix FT 210 (available from Lowes), FT 250, and FT 350

Additional equipment—

- Ladders (at least one for every two crewmembers)
- Fall protection equipment (harness, ropes, etc.)
- Job-specific personal protective equipment
- Equipment for removing wrapping material
  - ✧ Pliers, a flat-blade screwdriver, or small pry bar for removing staples
  - ✧ Tool belt with pouch to hold tools and discarded staples
  - ✧ Garbage bags for used wrapping material
  - ✧ Containers for used staples
  - ✧ Magnetic floor sweeper to remove staples discarded on the ground

Water handling equipment—

- Pump
- Pump fuel
- Sprinkler kits (NFES 0920)
- Gel or foam (must be listed on the qualified products list—refer to appendix C)
- If you install hose under the wrap to provide additional protection from embers, use sprinkler hose, soaker hose, or 1-inch fire hose with ⅛-inch holes drilled through one side at 18-inch intervals. Secure the hose using rubber-cushioned steel loop straps.

Appendix B—Wrapping Material Manufacturers and Products

Custom Laminating Corporation (formerly Cleveland Laminating—Federal Government sales only)

- 1,350 square feet
- Product number—CLC 6076
- Unrolled size—5 feet wide by 270 feet long
- Roll size—6 inches in diameter by 60 inches long
- Weight per roll—65 pounds
- Cost per roll (2013 dollars)—$415 (does not include shipping)
- Lead time—in most cases, small quantities can be shipped the next business day

Available from—

Custom Laminating Corporation
5000 River Road
Mt. Bethel, PA 18343
Phone: 570–897–8300
<http://www.customl.com>

To order, contact—

Nick Christesson
570–897–8300, ext. 228
ChristessonNick@CustomL.com

Jeff Metzger
570–897–8300, ext. 216
MetzgerJeff@CustomL.com

Firezat, Inc.

- Standard Duty Fire Shield
  - ✧ 1,500 Square Feet
  - ✧ Product number—STD5300
  - ✧ Unrolled size—5 feet wide by 300 feet long
  - ✧ Roll size—6 inches in diameter by 60 inches long
  - ✧ Weight per roll—75 pounds
  - ✧ Cost per roll (2013 dollars)—$786 (does not include shipping)
  - ✧ Lead time—within 24 hours if in stock
- Heavy Duty Fire Shield
  - ✧ 750 Square Feet
  - ✧ Product number—HDR5150
  - ✧ Unrolled size—5 feet wide by 150 feet long
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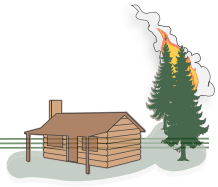
  - ✧ Weight per roll—62 pounds
  - ✧ Cost per roll (2013 dollars)—$679 (does not include shipping)
  - ✧ Lead time—within 24 hours if in stock

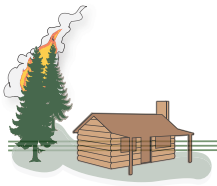
Available from—

Firezat, Inc.
3525 Del Mar Heights Road, Suite 905
San Diego, CA 92130
619–847–7556
<http://www.firezat.com>



Appendix C—Gel and Foam Information

- The current foam and gel qualified products list is available at <http://www.fs.fed.us/rm/fire/wfcs/index.htm#qpl>.
- Information about the effects of foam and gel on structures is available at <http://www.fs.fed.us/rm/fire/wfcs /documents/effstruc.pdf>.
- Information about removing gel from structures is available at <http://www.fs.fed.us/rm/fire/wfcs/documents /cleanup.pdf>.
- A current list of foam vendors is available at <http://www.fs.fed.us/rm/fire/suppliers/documents/foam.pdf>.
- A current list of gel (water enhancer) vendors is available at <http://www.fs.fed.us/rm/fire/suppliers/documents /waterenh.pdf>



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- Becky Timmons and Mike Giesey, Kootenai National Forest
- Matt Young, Clearwater National Forest

About the Authors

Wesley Throop joined MTDC as a project engineer in 1999. Throop previously worked at the Idaho National Laboratory's Advanced Test Reactor and on shipboard weapon-handling systems at the Puget Sound Naval Shipyard.

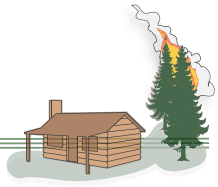
Theron Miller joined MTDC as a project leader in 2006. In 1997, Miller received his doctorate degree in forestry with an emphasis in natural resources social science from the University of Montana. After graduating, he remained at the university as a research and teaching professor focusing on applied social sciences directly related to management of natural resources on public lands. Miller's projects at MTDC are in the safety and health, recreation, facilities, and fire and aviation management program areas.

Library Card

Throop, W.; Miller, T. 2014. Protecting structures from wildland fire. Tech. Rep. 1451–2813–MTDC. Missoula, MT: U.S. Department of Agriculture, Forest Service, Missoula Technology and Development Center. 14 p.

The Forest Service has many remote structures, such as lookout towers and historic cabins, that require protection from wildfires. Structures can ignite because of radiant heat, contact with flames, or embers. A number of methods can be used to help protect structures from wildfire, including clearing combustible materials from the area around the structure and wrapping the structure with aluminum foil wrapping material to reflect heat. This report provides information on structure protection techniques based on information provided by Federal land management agency employees, Web sites, and vendors.

Keywords: aluminum foil wrapping materials, fire-resistant materials, fuel reduction, historic structures, remote structures, structure protection, wildfires, wrapping materials



For additional technical information contact MTDC:

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Missoula Technology and Development Center
5785 Hwy. 10 West
Missoula, MT 59808–9361
Phone: 406–329–3978
Fax: 406–329–3719
Email: wo_mtdc_pubs@fs.fed.us

Electronic copies of National Technology and Development documents are available on the Internet at:

http://www.fs.fed.us/pubs

Forest Service and Bureau of Land Management employees can search National Technology and Development documents, CDs, DVDs, and videos on their internal computer networks at:

http://fsweb.mtdc.wo.fs.fed.us/search/
http://fsweb.sdtdc.wo.fs.fed.us/